DIPHTHERIA.

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An infectious disease, *i. e.*, a disease dependent upon agencies introduced from without, and not dependent upon a primary organic change in the system.

There are two views of the procedure of this disease: One, that the general system becomes first affected, as in small-pox, and that the local manifestations arise subsequently. The other, that the local manifestation is primary, and the general symptoms secondary.

According to the first view, the morbific agent must have a period of incubation, followed by symptoms *first* general and *afterward* local.

Two other conditions control the theory of the spread or limitation of the disease:

One, the facility of yielding to the changes the agent tends to induce; the other, the power of resistance.

In all epidemics the facile take the disease and the resisting escape. The most facile die, and the least facile recover. In this view the objects of treatment are two:

One, to diminish the facility and increase the resistance, and the other to destroy the morbific agent itself.

The predominant theory entertained in this paper, is, that the mobific agent can be destroyed, and consequently that the disease can be stamped out, to return only when favoring conditions give it an individual origin, as in the first case which appeared.

The inspiration of this possibility is necessary to the contest with a disease which skulks so stealthily and kills so surely.

A child has been exposed to the infection—in two or three days a slight general indisposition, and a slight, ashy discoloration upon the veil of the palate appear; the child walks about with diminished interest in his play, and with a squeamish appetite; gets rapidly worse, and dies without obvious cause, or from inhibition of the heart's action; or an extensive membranous exudation covers the mouth, extends into the

pharynx, into the nose and Eustachian tubes with putrid decomposition of the exudations, and death results from rapid septic poisoning.

In other cases, the disease begins in the larynx, or extends into it, with engorgement or incrustation of the vocal cords and impediments to respiration, the patient dying of suffocation, if not carried off in one of the other ways; or the disease, with its train of exudations, travels down the trachea and into the bronchial tubes, producing first a rattle, as in bronchitis, and then complete solidification, as in pneumonia. The disease may begin wherever there is mucous membrane or a denuded surface of skin, and spread with no other limitation than the resistance either inherent or induced by treatment.

Trousseau relates a case of a patient whose chest became covered with an incrustation, beginning in a small patch in a point accidentally denuded. Commencing in any one place, it may spread or jump to others. It has its favorite seat in the back part of the roof of the mouth, and the anterior surface of the veil of the palate, because, perhaps, this surface is especially exposed to the contact of air charged with the infection, the membranes more anteriorly being protected by the thickness of the epithelium, and inferiorly by the saliva.

The morbific agent may attack wounds, whether conveyed by the air or inoculated directly by the contact of the products of exudation.

Though Trousseau and his associate Peter failed in their attempts to inoculate, the latter having the temerity to place in his own mouth, lint soaked in the exudations of a diphtheritic patient, yet the proofs of inoculation by design or accident are too numerous to be denied. In Oertel's chapter on this subject, in the first volume of Ziemssen's Cyclopædia, experiments are related of inoculation of the inferior animals—in the muscles by Oertel, Hueter and Tommasi, and in the cornea by Nasseloff and Elbert. In these inoculations the constitutional symptoms of diphtheria were produced, followed by the death of the animals.

The accidental inoculations have been numerous. It is not many years since Dr. Frick, a very distinguished physician of Baltimore, while medicating the throat of a diphtheritic patient received into his own mouth some of the morbific material coughed out by the patient. Local manifestations, general symptoms and death followed in a brief period. Trousseau relates the case of his colleague, Valleix, poisoned in the same way with the same sad result, and of another, who lost his life by sucking the blood and mucous from a tracheotomy wound. Hardly a year passes without the record in the medical journals of the loss of some physician by the same accident.

The direct application of the liquid or semi-solid material to an absorbing surface leads to a rapid development.

The period of incubation was in two instances found to be from two to five days by Oertel in his own practice. In these cases diphtheritic patients returned home and were kissed by members of the family, who in from two to five days manifested the symptoms of the disease.

With a resistance capable of opposing death by inhibition of the heart, by blood-poisoning and by suffocation, the patient may subsequently die of palsy of the muscles essential to vitality, as those of deglutition, or suffer for weeks or months with palsy of palate or limbs, and through the power of resistance, inherent or induced by treatment, make a final recovery.

This palsy is supposed to depend upon some general condition; for, while it ordinarily attacks muscles near the part previously the seat of exudation, it is not always so. Trousseau refers to an instance of palsy of the palate following a case of cutaneous diphtheria.

While the palsy is gradual in its approach, affecting first a part of a muscle, then the whole muscle and other muscles during the period of increase, it leaves as gradually, and generally disappears entirely.

In Oertel's chapter already referred to, many pages are devoted to the proof that diphtheria is produced by, and attended with, bacteria—especially bacterium sphericum or micrococcus—concluding with the maxim: "Without bacteria no diphtheria."

This vegetation is supposed to penetrate the tissues and even to enter the blood vessels, poisoning the blood by its presence, and imparting to it the property of staining, like plum-juice, so that the patient may die of a double septicæmia, that of vegetable decay and that of animal putresence.

The appearance of albumen in the urine shows a profound influence upon both nervous and vascular systems, like that which is produced in small-pox and scarlet fever. The condition is not distinctive of the kind of disease, but of its severity.

The existence of albuminuria is not supposed to sustain any uniform relation to the production of paralysis, as the latter condition occurs as a sequel of diphtheria in cases in which the urine has not exhibited albumen, though it occurs more often after the occurrence of this condition.

Whether, as a basis of observation and reflection, the hypothesis of a foreign growth, vegetable or animal, fastening itself upon the surface and penetrating the tissues be assumed, or that of chemical changes under the influence of altered or defective vital forces, observation and verification, and not mere theory, must finally control the practice. Observation, however, must be controlled by previously accepted ideas, or it is all at random and can come to nothing.

While the origin of the disease by an infection is generally accepted, the mode of infection and the consequent ruling idea of that mode are conceived of either as primarily local, followed by general symptoms, like that of hospital gangrene and traumatic contagious erysipelas, or as general, like that of small-pox, followed by local manifestations.

The latter theory is accepted by Flint in his work on Practice. This is his positive language: "In cases in which the parts adjacent to the fauces become affected, the affection is not to be considered as spreading to these parts, but they are consecutively invaded; *i. e.*, the affection of these parts, as of the fauces, is a local manifestation of a constitutional disease."

This idea controls the practice, and he says: "Local treatment with a view to prevent reinfection of the system has no rational ground of support. Another object of local treatment is to arrest the progress of the exudation. But, with reference to this object it is to be considered that the local disease does not, properly speaking, spread, but the progressive extension and successive invasion of different parts, are due to the agency of an internal determining influence. The restriction of the diphtheritic inflammation in one case to a small space, and its wide diffusion in another case, depend upon the essential morbid condition which constitutes the disease; and, if so, topical treatment will be likely to exert little or no effect in limiting the amount and the extent of the local manifestations."

On the contrary, the local origin of the disease has been the theory accepted by the great majority of the profession—by Bretonneau, who unified the disease and gave name to it; by Trousseau in his Clinical Lectures, and by Oertel in Ziemssen's Cyclopædia, the latter adopting the short expression already quoted, "Without bacteria no diphtheria."

The short period of incubation, in cases of direct contagion, favors the theory of the local origin of the disease, and the consequent importance to be attached to local treatment.

In this view, we should say that the confinement of the disease to a point or small patch, or its failure altogether to germinate in one class, and in another class of persons its indefinite spread with albuminuria, inhibition of the heart, septic poisoning and subsequent palsy, depend upon the degree of resistance; the most facile yielding first to the implantation, and then to the local development, then to the constitutional disturbances and the subsequent deteriorations, while the most resisting present a soil unfavorable to the reception of the contagion and unfavorable to its subsequent manifestations.

In this view of the nature of the disease, the indications for treatment divide themselves into three classes:

1. To destroy or weaken the infection or contagion.
2. To increase the resistance of the constitution.
3. To remedy functional irregularity or impairment.

The result of observation is the theory of an infection which attacks the feeble and the strong alike, having an especial affinity for childhood. The first object, therefore, in the treatment of the disease, is the mitigation or destruction of this infection.

In the disagreement of theorists, it may, for our convenience, be assumed that the material of this infection is an albuminoid substance which acts as a virus, inducing changes like unto itself in the animal substances with which it combines. In this view the bacteria feed upon this material, become saturated with it, and carry it wherever they go, imparting it to whatever they touch.

As vinous fermentation may be as well explained* in this way, it is simpler, to suppose with Pasteur, that the vegetation, instead of merely accompanying and facilitating the albuminoid formation and diffusion, is really the cause of the albuminoid changes, the incipiency of the process being spores derived from the atmosphere and implanted in an albuminous soil, instead of an original chemical change affording food for the organic growths.

If, according to Virchow, Oertel and some others, the poison lies in the implantation and germination of bacteria—microscopic objects on the confines of the possibility of vision—the first, and constant indication is to weaken or destroy the bacteria.

It is stated in the chapter in Ziemssen, by Oertel, that Lugol's solution is unfavorable to the existence of this minute vegetation. This is a clue to a possible successful treatment. The objection to the stronger local applications is the impossibility in most cases, of completely covering the affected surface and destroying all the vegetation, while in the intervals of the applications the undestroyed growth goes on. If instead of the bold attack, a solution of a medicine unfavorable to the morbific agent can be employed, so weakened as to be constantly applied without injury to the surface affected, and to the air passages beyond, to which the disease may spread, a step in advance has been made.

Taking the hint of Oertel as to Lugol's solution, this compound has been very much diluted and employed as a perpetual spray to be breathed by the patient. Trousseau mentions the employment of medicated vapors by the apparatus of Sales-Giron, but does not state the kind or the temperature of the agents employed.

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*See an instructive paper on Bacteria, by Dr. L. A. Stimson, in the *Popular Science Monthly* for February, 1875.

While ice, or other cold applications, may be agreeable and harmless in the mouth, it is undesirable to introduce a cold spray or vapor into the lungs.

Recognizing the importance of warmth and moisture to prevent the drying of the exudations, especially if in the larynx, and the favoring influence of warmth and moisture in inducing such a suppuration as may early detach the crusts, the suggestion has occurred to me to make some observations upon the effects of a weak solution of iodine blown off in a spray, or nebulization by the steam atomizer.

This apparatus supplies the theoretic conditions of treatment. The problem is to find an agent which is deodorant and antiseptic; which is unfavorable to bacterial growth, and can be employed with safety to the healthy mucous surfaces.

A solution, not stronger than one-fourth of a grain of iodine to the ounce of water, holding in solution four grains of iodide of potassium, can be inspired for a long time with impunity. The face of the patient should be about two feet from the apparatus in the expanded cone of the nebula. While the agent is applied to all the surfaces fanned by the breath, it is also absorbed and serves to oppose the septic tendency, which is one of the dangerous elements of the disease.

The same theoretic considerations point to the use of these agents, nebulized and floating in the atmosphere, in the treatment of scarlet fever and small-pox, and indeed in any disease in which the emanations from the body of the patient are supposed to carry the germs of the same disease to uninfected persons. The power of the nebulized iodine to disinfect the atmosphere of a room rendered extremely disagreeable by the emanations from a diphtheretic mouth and throat is most prompt and lasting. A patient so suffering experiences speedy relief very soon after the treatment is commenced, so that there is a double comfort for patient and attendants.

It is probable that with an early employment of this means there would never be perceived the gangrenous odor which is often excessively offensive.

The room in which the patient lies is at the same time pervaded by an iodine vapor, unfavorable to the spread of the seeds of contagion.

In cases in which the larynx has become the seat of incrustation, a very weak solution of lactic acid may be employed in alternation with iodine, on account of its known tendency to secure the softening, and, consequently, to prevent the hardening, of the exudations.

With a temperature at 90 F. a moist atmosphere, and the breathing of the iodine spray from a steam jet, or by a hand jet from a hot solution, the conditions are secured which are unfavorable to the multiplication

of the local disease, and unfavorable to septic poisoning. At the same time that the patient is subjected to the slow but permanent action of iodine in this way, other treatment, both local and general, can be employed.

Among the local applications, one in great favor is a solution of euchlorine, ordinarily extemporized by placing in a bottle some chlorate of potash, pouring in some hydrochloric acid, and then filling the bottle with water to absorb the vapor of euchlorine which results from the reaction.* The agent is antiseptic and deodorant, and when sufficiently diluted can be swallowed with impunity. It is diluted to such a degree as not to be disagreeably pungent. Dr. Henry C. Stewart, of this city, has employed this agent for many years with great satisfaction. It cannot well be inhaled in the manner suggested for iodine, on account of its unfriendliness for the air passages.

The same objection applies to chlorine, bromine, carbolic acid and salicylic acid, all of which may be advantageously applied to the mouth and fauces in gargles or by brush or probang.

From the known power of tannin to harden this and other forms of false membrane, its use is contra-indicated.

Acetate of copper and honey found favor in Bretonneau's practice.

The strong caustics are coming into disfavor, not because they are wrong in theory, but on account of the impossibility, in most cases, of reaching the whole diseased surface.

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*Dr. G. V. Black, of Jacksonville, has devised a convenient plan of an extemporized apparatus. In a wide-mouthed stoppered bottle, half filled with water, is suspended a small phial half full of chlorate of potash, upon which hydrochloric acid is dropped by a dropping tube. The stopper is applied, and the chemical reactions develope the gas or euchlorine, which is absorbed by the water which escapes contamination with the acid.

An impure solution can be prepared by placing a few crystals of the chlorate of potassa in a dry bottle and pouring a little hydrochloric acid upon them. When the bottle is seen to be filled with the yellowish gas fill it slowly with water.

He contributes the following note upon the chemical reactions:

When three parts of hydrocloric acid is poured over one part of chlorate of potassa a yellow gas is given off, called euchlorine by Sir H. Davy, its discoverer. Its reaction may be expressed thus:

$2KOClO_5$ and HCl equals $2KCl$. $6HO$ less $3Cl_2O_2$ or $2KClO_3$ and $6HCl$ equals $2KCl$ $3H_2O$ less $3Cl_2O$.

Water absorbs from 8 to 10 volumes of the gas, and when fully saturated its color is similar to very clear olive oil, but not so intense. It possesses, in a modified degree, the properties of free chlorine, and for many years was supposed to be a *mixture* of gases. It is now admitted to be a true chemical compound, though a very unstable one, it being liable to speedy spontaneous decomposition. It is decomposed slowly by light, or by heat above 70 or 80 deg. It should be prepared when wanted, or it should be kept closely corked in a cool dark place.

Tincture of iodine, hydrochloric acid, nitrate of silver, chloride of iron and the actual cautery have been resorted to, in order to stop the spread of the ashy discolorations, with some success, but with such disheartening failures as to lead to a distrust of the efficacy of local treatment altogether.

These ideas, with regard to the disease and its treatment, inspire the hope of its prevention, and the consequent suppression of an epidemic. In the case of laryngeal complications in which 95 per cent. die, new hope can be cherished of the success of tracheotomy. Without an antiseptic treatment the local disease is likely to extend into the bronchial tubes, or to attack the wound, producing, in the patient, the effects which have resulted from the inoculation of animals. The latter results, however, can be opposed by the cauterization of the surfaces, as is done when the incisions are made in the method of galvano-cautery, or by the infiltration of the tissues with tincture of chloride of iron poured into the wound before the trachea itself is penetrated.

The excess of the liquid can be wiped out with cotton to save the sponge which would be ruined by the liquid.

The incision of the trachea is best made according to the method of Brainard, in a curved line, the convexity being to one side. A round piece, a quarter of an inch in diameter, is cut from the convexity to furnish an opening for respiration. The wound is held apart by a wire bent in the shape of an eye speculum.

The second indication is, to increase the constitutional resistance to the inception of the disease, and its reaction against it when once invaded. Alkalies and arterial sedatives, on the present accepted theory of the disease, are excluded, notwithstanding the high favor in which carbonate of soda was once held in France.

Alcohol may aid in resisting the tendency to molecular dissolution. Chloride of iron may preserve the vital conditions of the blood, and, without our understanding its mode of action, quinia is probably the most powerful supporting agent.

Mercury is given upon the theory of its antiplastic power—a theory upon which alkalies are given, but modern experience is unfavorable. In croup, which is non-infectious, sporadic, and often hereditary, the conditions are different. The importance often placed upon food in the acute period is overestimated; for while the patient can eat he is likely to be fed, and when he cannot eat, he will not.

The third indication is, chiefly, to meet the palsies which follow in the train after reaction from the acute period.

The therapeutics include food, quinia, pepsin, friction, passive motion, and, I should say, faradization; for though Oertel is unfavorable to electricity in any form.

It is an encouraging feature of diphtheritic paresis and palsy that if the patient can be kept alive he will generally get well.

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